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DEVELOPMENT AND STANDARDIZATION OF THE AIR FORCE
OFFICER QUALIFYING TEST FORM L

By

Robert E. Miller

PERSONNEL RESEARCH DIVISION
Lockheed Air Force Base, Texas

May 1972

Approved for public release; distribution unlimited.

LABORATORY

AIR FORCE SYSTEMS COMMAND
BROOKS AIR FORCE BASE, TEXAS

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AFHRL-TR-72-47

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FOREWORD

Replacement forms of operational tests for officer selection and classification are produced biennially. The Air Force Officer Qualifying Test Form K was replaced by Form L in Fiscal Year 1972. Construction and standardization of Form L were accomplished under Project 7719, Air Force Personnel System Development in Selection, Assignment, Evaluation, Quality Control, Retention, Promotion, and Utilization; Task 771912, Selection and Classification Instruments for Officer Personnel Programs.

This report has been reviewed and is approved.

George K. Patterson, Colonel, USAF
Commander

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ABSTRACT

(L)

In accordance with the normal replacement cycle, a new form of the ~~Air Force~~ ~~Air Force Officer Qualifying Test (AFOQT)~~ was developed for implementation in ~~Fiscal Year 1972~~ ~~FY-1972~~. The new form is designated Form L. It resembles other recent forms in type of content, organization, and norming strategy. Like other forms, it yields Pilot, Navigator-Technical, Officer Quality, Verbal, and Quantitative composite scores for operational use. Standardization involved the use of the Project TALENT battery in a way which permits relating AFOQT scores to Air Force Academy candidates and to 12th grade males in the Project TALENT national survey. Form L differs from earlier forms by the introduction of Digitek answer sheets and by a slight shortening which does not reduce the total amount of elicited scorable behavior. Although new forms of the AFOQT can not be validated immediately, new validation data from older forms are assumed to characterize new forms also. Some new validation data for flying training criteria are presented.

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DEVELOPMENT AND STANDARDIZATION OF THE AIR FORCE OFFICER QUALIFYING TEST FORM L

I. INTRODUCTION

The Air Force Officer Qualifying Test (AFOQT) is used throughout the Air Force for the selection and classification of officer personnel. The development and characteristics of previous forms of this test have been described in a series of reports (Valentine & Creager, 1961; Miller & Valentine, 1964; Miller, 1966a; Miller, 1968; Miller, 1970). This report continues the series by describing the development and standardization of AFOQT Form L.

Production schedules for the AFOQT call for the development of a new form every two years to minimize obsolescence and the possibility of compromise. Form L became operational in the Air Force Reserve Officer Training Corps (AFROTC) program in September 1971 and in all other programs in January 1972. No other operational test for officer programs was implemented in Fiscal Year 1972.

II. DESCRIPTION

AFOQT Form L resembles its recent predecessors in type of content and organization. It contains 524 items grouped into 13 subtests from which are derived the Pilot, Navigator-Technical, Officer Quality, Verbal, and Quantitative composite scores. These five composites are used operationally in Air Force officer programs. The subtests are not scored separately except for research purposes. The organization of the test is as outlined in Table 1.

Construction and standardization of Form L are essentially like Form K. As in Form K, three sets of conversion tables are provided. The choice of the proper table is based on the educational level of the examinee at the time of testing. The research base for the multiple tables is in two independent studies (Gregg, 1968; Tupes & Miller, 1969) which showed the extent to which formal education has an elevating effect on AFOQT scores.

Form L differs from its predecessors mainly in the type of answer sheet used. In accordance with trends toward increased automation of test processing, Form L is provided with Digitek

answer sheets. These permit scoring by hand, by Digitek machine, or by computer following Digitek processing. It is anticipated that most scoring in the field will continue to be by hand, but the other options are available. In the AFROTC program, special answer forms are used, and centralized scoring is accomplished by video scanner and computer.

Two Digitek answer sheets, printed on both sides, are sufficient to accommodate the entire AFOQT and all information normally recorded on the Officer Qualifying Test Record (AFOQT), AF Form 338. It was necessary to drop two items from the Officer Biographical Inventory subtest to achieve this accommodation. Characteristically, the Officer Biographical Inventory contains several unscored items, and two of these were dropped. Though slightly shorter than Form K, the new form elicits the same amount of scorable behavior.

III. ITEM SELECTION

Form L was constructed to have the same difficulty as preceding forms. The intent was to select for each subtest a set of items in which the item of median difficulty is answered correctly by 50 percent of the examinees, with the other items having a fairly wide difficulty range above and below this level. Table 2 shows the range of difficulty and median difficulty of each subtest in terms of the proportions of a group of examinees who give the correct responses. The lower values represent the more difficult items.

Table 2 also provides internal consistency data in the form of phi coefficients between the correct responses and the total score on the subtests to which the items belong. The coefficients are based on the upper and lower 27 percent of the sample used in obtaining the difficulty data.

The two biographical subtests in Form L are not included in Table 2. For biographical items, the concept of difficulty is somewhat different than for other items. Moreover, internal consistency need not be high for biographical items. There is evidence from the content of the biographical subtests that their internal consistency is low.

Table 1. Content and Organization of AFOQT Form L^a

Booklet and Subtest	Number of Items	Composite				Quantitative
		Pilot	Navigator-Technical	Officer Quality	Verbal	
Booklet 1 (AFPT 962)						
Quantitative Aptitude	60		X	X		X
Booklet 2 (AFPT 963)						
Verbal Aptitude	60			X	X	
Officer Biographical Inventory ^b	98			X		
Booklet 3 (AFPT 964)						
Scale Reading ^c	48		X			
Aerial Landmarks ^c	40		X			
General Science	24		X			
Booklet 4 (AFPT 965)						
Mechanical Information	24	X		X		
Mechanical Principles	24	X		X		
Booklet 5 (AFPT 966)						
Pilot Biographical Inventory	50	X				
Aviation Information	24	X				
Visualization of Maneuvers ^c	24	X				
Instrument Comprehension ^c	24	X				
Stick and Rudder Orientation ^c	24	X				
Total	524					

^aAssociated administrative and scoring manuals are AFPT 960 and 961, respectively. Associated answer sheets are AFPT 967 and 968. Scale Reading and Aerial Landmarks are scored R-W/4; Visualization of Maneuvers and Instrument Comprehension are scored R-W/3. Other subtests are scored rights only.

^bNot administered to female applicants.

^cSpeeded subtests.

Table 2. Item Difficulty and Internal Consistency of AFOQT Form L^a

Subtest	Difficulty		Internal Consistency	
	Range	Median	Range	Median
Quantitative Aptitude	.12-.88	.56	.19-.87	.47
Verbal Aptitude	.23-.83	.52	.32-.78	.50
Scale Reading	.22-.93	.58	.17-.87	.44
Aerial Landmarks	.21-.86	.62	.24-.80	.50
General Science	.21-.80	.56	.29-.88	.53
Mechanical Information	.29-.88	.58	.23-.83	.58
Mechanical Principles	.32-.84	.57	.18-.79	.50
Aviation Information	.27-.82	.52	.24-.90	.52
Visualization of Maneuvers	.22-.95	.56	.06-.61	.35
Instrument Comprehension	.23-.97	.52	.06-.71	.43
Stick and Rudder Orientation	.45-.96	.76	.28-.83	.52

^aBased on samples of 400 or more student officers.

IV. RELIABILITY AND INTERCORRELATIONS

Appropriate data for determination of reliability and intercorrelations of a new AFOQT form do not become available until the test has been in use for a considerable time. The initial determination of these data is based on previous forms and is regarded as an estimate for the new form. Reliabilities estimated in this way are shown in Table 3, and similarly estimated intercorrelations are shown in Table 4. Both tables are based on results from 785 AFROTC cadets. Biographical subtests are not included in the composite reliabilities.

The mean intercorrelation among the five composite scores, as determined by z transformation of the coefficients, is .58. In part, the intercorrelation of the composites is produced by the presence of subtests which are common to two or more composites, and by the containment of two of the composites within Officer Quality. The effects of these overlapping situations can be removed statistically. When removed, the mean intercorrelation of the composites fell to .34.

V. STANDARDIZATION

Although the Air Force Academy candidate group has traditionally been the standardization population for the AFOQT, this group ceased to be available for AFOQT administration after 1960. An indirect method of relating new AFOQT forms to prior Academy candidate groups was therefore devised. Development of this method is reported in detail elsewhere (Dailey, Shaycoft, & Orr, 1962).

Briefly, the method consists of defining composites of Project TALENT tests which predict each AFOQT composite and locating in each TALENT score distribution the percentile levels equivalent to those previously found for the AFOQT in an Academy candidate group. A new form is standardized by administering it with the TALENT composites and performing equipercentile conversions from percentile levels in the TALENT composites to corresponding levels in the new AFOQT composites. Samples for this administration are basic airmen stratified on the Armed Forces Qualification Test (AFQT) by deciles in the percentile range from 21 to 100.

Ideally, a single stratified sample of basic airmen should be used in standardizing all AFOQT composites, but the amount of testing to which such a sample would be subjected is unreasonable.

Table 3. Estimated Reliability for AFOQT Form L

	Reliability
Quantitative Aptitude	.90 ^a
Verbal Aptitude	.85 ^a
Scale Reading	.85 ^b
Aerial Landmarks	.54 ^b
General Science	.78 ^a
Mechanical Information	.73 ^a
Mechanical Principles	.72 ^a
Aviation Information	.73 ^a
Visualization of Maneuvers	.77 ^b
Instrument Comprehension	.65 ^b
Stick and Rudder Orientation	.73 ^b
Pilot Composite	.90 ^c
Navigator-Technical Composite	.92 ^c
Officer Quality Composite	.91 ^c
Verbal Composite	.85 ^a
Quantitative Composite	.90 ^a

^aDetermined by Kuder-Richardson Formula 20.

^bDetermined by test-retest.

^cDetermined by formula for reliability of a composite (Wherry & Gaylord, 1943).

Consequently, three stratified samples of approximately 1,000 cases each were used in standardizing the various composites. The effectiveness of the stratification is shown in Table 5, where the AFQT distributions of all possible pairs of samples are compared by chi-square. No significant differences between the distributions are found.

The composition of the TALENT composite corresponding to each AFOQT composite is shown in Table 6. The Academic TALENT composite is used in standardizing AFOQT Officer Quality. This TALENT Composite corresponds to Officer Quality minus the Officer Biographical Inventory. A constant value representing the operational mean of the biographical inventory is then added to the results.

These operations yield AFOQT conversion tables appropriate for examinees with less than two years of college. Findings from the studies of the effects of education on AFOQT scores are incorporated into the tables for college graduates and OTS applicants who are close to college graduation. Intermediate tables are developed by taking half the difference at each percentile between the two sets of tables.

Table 4. Estimated Intercorrelations of Subtests and Composites for AFOQT Form L

Subtest or Composite	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1 Quantitative Aptitude															
2 Verbal Aptitude	.35														
3 Officer Biographical Inventory	.09	.17													
4 Scale Reading	.58	.26	.10												
5 Aerial Landmarks	.28	.16	.05	.33											
6 General Science	.57	.43	.01	.31	.17										
7 Mechanical Information	.32	.14	-.06	.16	.06	.50									
8 Mechanical Principles	.45	.21	-.09	.29	.22	.54	.62								
9 Pilot Biographical Inventory	.00	-.16	.13	.02	.08	.10	.42	.28							
10 Aviation Information	.20	.38	.07	.16	.16	.47	.45	.43	.26						
11 Visualization of Maneuvers	.27	.27	.02	.28	.30	.33	.30	.35	.19	.36					
12 Instrument Comprehension	.29	.23	.05	.29	.30	.35	.30	.39	.26	.38	.51				
13 Stick and Rudder Orientation	.29	.16	.02	.28	.30	.26	.27	.41	.26	.36	.42	.51			
14 Pilot Composite	.36	.23	.04	.31	.31	.50	.67	.70	.60	.65	.65	.72	.74		
15 Navigator-Technical Composite	.86	.39	.05	.70	.53	.71	.55	.68	.16	.40	.42	.45	.43	.62	
16 Officer Quality Composite	.76	.74	.55	.48	.25	.52	.22	.31	-.02	.32	.28	.29	.25	.33	.69

Table 5. Homogeneity of AFOQT Form L Normative Samples

Samples Compared	Chi Square	df	P
Pilot and Navigator-Technical	0.382	7	>.99
Pilot and Officer Quality	0.216	7	>.99
Navigator-Technical and Officer Quality	0.173	7	>.99

Table 6. Composition of TALENT Composites Corresponding to AFOQT Composites^a

	Number of Items	Weight in TALENT Composite				
		Milot	Navigator-Technical	Academic	Verbal	Quantitative
102 Vocabulary (Information)	21					2
103 Literature (Information)	24					2
106 Mathematics (Information)	23		3	2	2	2
110 Aeronautics and Space (Information)	10	3		2		3
111 Electricity and Electronics (Information)	20	1	2			
112 Mechanics (Information)	19	3				
250 Reading Comprehension	48			1	1	
270 Mechanical Reasoning	20	3	3			
281 Visualization in Two Dimensions	24	1				
282 Visualization in Three Dimensions	16	2	3			
312 Mathematics II: Introductory	24		3	2		2
333 Mathematics III: Advanced	14	2		3		3
Total	263					

^aData assembled from Dailey *et al.* (1962, Table 9 and unpublished supplement).

In effect, then, each new AFOQT form is indirectly tied to the Air Force Academy candidate population and to the 12th grade male sample used in the Project TALENT national survey. A constancy of meaning of scores is thus maintained across successive AFOQT forms. Stratification of the airman samples makes it possible to compare scores on one composite with scores on another. Finally, the incorporation of educational effects provides the same meaning for a given percentile score at different educational levels.

VI. SCORE DISTRIBUTIONS

The raw TALENT composite scores corresponding to AFOQT percentiles are identical for Forms K and L. They have been reported elsewhere (Miller, 1970). The cumulative percentage distributions of TALENT composite scores in the basic airman normative samples for successive AFOQT forms tend to vary slightly. The results for Form L are shown in Table 7. They are compared in this table with results from the basic airman sample on which the TALENT composites

were originally developed. The similarities and differences which this table reflects have been observed in all recent forms of the AFOQT.

Raw score means and standard deviations for AFOQT Form L in five groups of examinees are given in Table 8. Only the data for the stratified basic airman samples are computed. Other data are estimated from the sources indicated in the table. In general, differences among the groups are in the expected directions.

VII. VALIDATION

Most AFOQT validation studies involve accumulation of data over a prolonged period, and usually more than one form of the test is included. New forms can not be validated immediately, but it is assumed that their validities are comparable to those of older forms at least in an approximate way.

Previously unreported validation data have recently been developed for the AFOQT. Some of these data are entirely new and based on recent

Table 7. Cumulative Percentage Distributions of TALENT Composites in Original Air Force TALENT Sample and AFOQT Form L Normative Samples *

AFOQT Percentile	TALENT Composite					
	Pilot		Navigator-Technical		Academic	
	AF Talent	AFOQT Norm	AF Talent	AFOQT Norm	AF Talent	AFOQT Norm
95	0.8	1.0	0.6	1.1	0.1	0.2
90	1.6	1.7	0.9	1.4	0.4	0.8
85	2.5	2.7	1.3	1.7	..	1.3
80	3.3	4.6	1.6	1.9	0.6	1.7
75	4.4	6.4	2.0	2.6	0.9	1.9
70	6.1	8.7	2.7	3.7	1.3	2.4
65	7.4	10.2	3.2	4.5	1.7	3.1
60	9.2	12.9	3.8	5.6	2.2	4.3
55	10.4	14.0	4.5	6.2	2.7	5.3
50	11.6	15.2	5.3	7.6	3.4	6.2
45	13.3	18.0	6.2	9.2	3.8	7.1
40	15.5	19.9	7.3	10.3	4.5	8.2
35	17.7	22.6	8.3	12.1	5.4	9.7
30	21.2	25.3	10.2	14.4	6.6	11.2
25	25.1	27.5	12.4	16.9	8.2	13.4
20	29.3	32.6	15.2	19.9	10.5	15.9
15	34.8	38.6	18.6	23.6	13.6	21.8
10	42.5	47.5	23.5	30.8	18.4	28.7
05	56.6	62.2	34.4	42.4	29.5	44.1
01	100.0	100.0	100.0	100.0	100.0	100.0

*N of original Air Force TALENT sample = 2,489. Ns of AFOQT Form L normative samples range from 1,036 to 1,049 for the various composites.

forms. Some are recomputations based on meaningful subsets of older and previously reported data. The results do not give a comprehensive picture of AFOQT validities, but an extensive summary has been published (Miller, 1969).

The previously unreported data are shown in Table 9. Most of the validity coefficients are not corrected for range restriction, but one set of Navigator-Technical validities is corrected.

Coefficients which are statistically significant at the .05 level or beyond are indicated by asterisks.

Among the first three sets of data in the table are some validities which can be compared directly with earlier results (Miller, 1966b). These coefficients are all in the range from .32 to .36. The older coefficients with which they can be compared are in the range from .20 to .28. Hence, the validities of the Pilot composite for prediction

Table 8. Raw Score Means and Standard Deviations of AFOQT Form L in Five Groups

Composite	Stratified Basic Airmen ^a		12th Grade Males ^b		Less Than Two Years College ^c		Two or More Years College ^c		College Graduates ^c	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Pilot	75.2	24.9	74.3	25.0	100.5	25.5	103.5	26.0	107.5	24.0
Navigator-Technical	67.0	26.3	71.0	18.4	109.5	20.4	118.5	15.4	124.5	13.6
Officer Quality	71.6	17.6	74.0	26.5	107.5	17.4	114.5	15.4	122.5	12.2
Verbal	21.6	10.7	19.5	15.3	36.5	11.6	40.5	9.6	43.5	9.6
Quantitative	19.1	9.1	21.2	9.9	36.5	8.6	40.5	7.6	44.5	6.8

^aStratified on AFQT deciles in the range of the 21st through the 100th percentile. Ns range from 1,036 to 1,049 for the various composites.

^bData estimated from Dailey *et al.*, based on 4 percent subsample of 12th grade males in original Project TALENT study. N = 2,403.

^cData estimated from AFOQT Form L conversion tables.

Table 9. Estimated Validities for AFOQT Form L

Criterion	Composite				Sample
	Pilot	Navigator-Technical	Navigator-Technical Corrected	Officer Quality	
Flying Deficiency Attrition	.36*				AFROTC FIP graduates in UPT classes 6901-6904. N = 676.
Other Attrition	.30*				
Total Attrition	.36*				
Flying Deficiency Attrition	.36*				OTS graduates in UPT classes 6901-6904. N = 735.
Other Attrition	.16*				
Total Attrition	.32*				
Flying Deficiency Attrition	.31*				Two above samples combined. N = 1,411.
Other Attrition	.17*				
Total Attrition	.29*				
Total Attrition	.39	.76*		.57*	Graduates of AFROTC Detachments 015, 130, 605, 755, and 790 in UPT Classes 63A-65B. N = 25.
Academic Grade	.32*	.48*	.56*	.40*	AFROTC, OTS, and Academy graduates in UNT classes
Flying Grade	.13*	.25*	.30*	.15*	
Academic Attrition	.28*	.34*	.40*	.25*	6303-6504. N = 1,302.
Flying Deficiency Attrition	.11	.20*	.24*	.18*	
Self-Initiated Attrition	.27*	.06	.07	-.08	
Total Attrition	.19*	.22*	.26*	.14*	

*Statistically significant at .05 level or beyond.

of undergraduate pilot training criteria appear to be at least as good as when last examined.

The data from flying training classes in Fiscal Years 1963 through 1965 are recomputed from subsets of previously reported data (Miller, 1966b). The data on student pilots from selected AFROTC detachments are assumed to be based mainly on members of minority groups. This is a very small subsample and yields results which are merely suggestive. A larger but similarly defined

subsample could not be identified in the original data, nor were there any criteria other than total attrition for which as many as 20 cases were available. The navigator validities in the table are recomputed from the same study but with aviation cadets and miscellaneous sources of commission omitted. In contrast to the original study, the recomputation produces significant Navigator-Technical and Officer Quality validities for total attrition.

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Unclassified

Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) Personnel Research Division Air Force Human Resources Laboratory Lackland Air Force Base, Texas 78236		2a. REPORT SECURITY CLASSIFICATION Unclassified
2b. GROUP		
3. REPORT TITLE DEVELOPMENT AND STANDARDIZATION OF THE AIR FORCE OFFICER QUALIFYING TEST FORM L		
4. DESCRIPTIVE NOTES (Type of report and inclusive dates)		
5. AUTHOR(S) (First name, middle initial, last name) Robert E. Miller		
6. REPORT DATE May 1972	7a. TOTAL NO. OF PAGES 7	7b. NO. OF REFS 11
8a. CONTRACT OR GRANT NO.	8b. ORIGINATOR'S REPORT NUMBER(S) AFHRL-TR-72-47	
b. PROJECT NO. 7719	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)	
c. Task No. 771912		
d. Work Unit No. 77191204		
10. DISTRIBUTION STATEMENT Approved for public release; distribution unlimited.		
11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY Personnel Research Division Air Force Human Resources Laboratory Lackland Air Force Base, Texas 78236	
13. ABSTRACT <p>In accordance with the normal replacement cycle, a new form of the Air Force Officer Qualifying Test (AFOQT) was developed for implementation in Fiscal Year 1972. The new form is designated Form L. It resembles other recent forms in type of content, organization, and norming strategy. Like other forms, it yields Pilot, Navigator-Technical, Officer Quality, Verbal, and Quantitative composite scores for operational use. Standardization involved the use of the Project TALENT battery in a way which permits relating AFOQT scores to Air Force Academy candidates and to 12th grade males in the Project TALENT national survey. Form L differs from earlier forms by the introduction of Digitel answer sheets and by a slight shortening which does not reduce the total amount of elicited scorable behavior. Although new forms of the AFOQT can not be validated immediately, new validation data from older forms are assumed to characterize new forms also. Some new validation data for flying training criteria are presented.</p>		

Unclassified

Security Classification

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Air Force Officer Qualifying Test classification tests educational effects intercorrelations internal consistency item difficulty navigator training prediction officer selection and classification pilot training prediction Project TALENT reliability score distributions selection tests test construction test standardization validity						

Unclassified

Security Classification